P. ENT COOPERATION TREA

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF THE RECORDING OF A CHANGE

(PCT Rule 92bis.1 and Administrative Instructions, Section 422)

To:

FRY, Alan, Valentine
Fry Heath & Spence
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53 High Street
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ROYAUME-UNI

Date of mailing (day/month/year)
21 June 2000 (21.06.00)

Applicant's or agent's file reference
P57223F

IMPORTANT NOTIFICATION

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PCT/GB99/00567

International filing date (day/month/year)
02 March 1999 (02.03.99)

1. The following indications appeared on record concerning:

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PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

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NOTIFICATION OF THE RECORDING OF A CHANGE

(PCT Rule 92bis.1 and Administrative Instructions, Section 422)

To:

FRY, Alan, Valentine
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PATENT COOPERATION TREATY

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NOTIFICATION OF THE RECORDING OF A CHANGE

(PCT Rule 92bis.1 and Administrative Instructions, Section 422)

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To:

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NOTIFICATION OF THE RECORDING OF A CHANGE

(PCT Rule 92bis.1 and Administrative Instructions, Section 422)

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PATENT COOPERATION TREATY

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Assistant Commissioner for Patents
United States Patent and Trademark Office
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Washington, D.C.20231
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in its capacity as elected Office

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Applicant: BASTABLE, Brian, John et al	

1. The designated Office is hereby notified of its election made:

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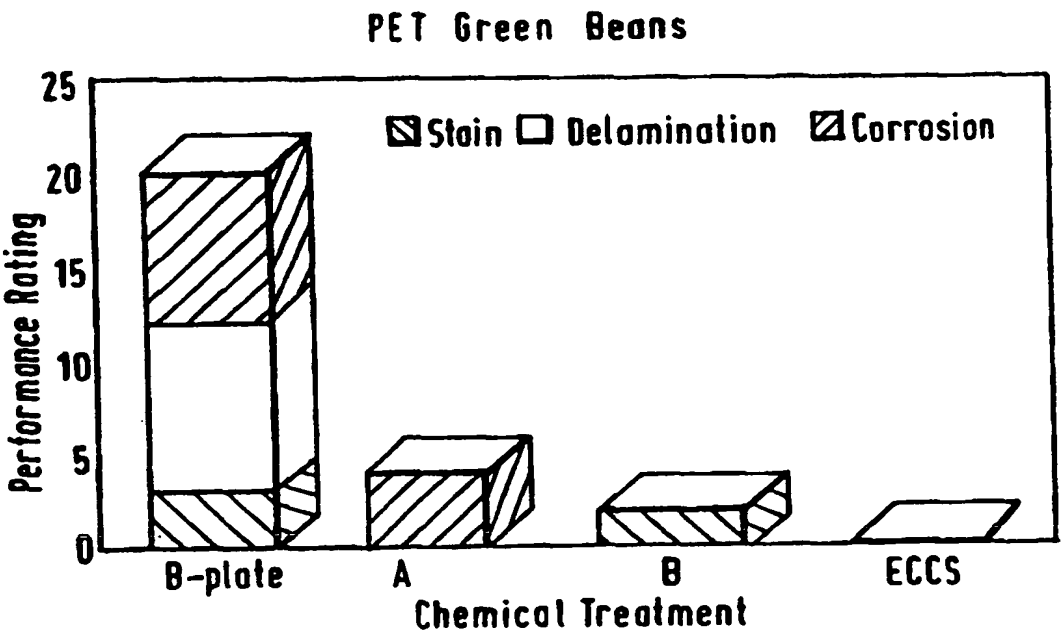

(57) Abstract

A process for producing laminated metal strip which comprises the steps of chemically treating the strip to form on at least one of its surfaces a non-metallic coating, and applying to that coated surface a coating of a thermoplastic resin to form a layer thereon.

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LAMINATED METAL STRIP

This invention relates to laminated metal strip for use especially, but not exclusively, in the packaging industry and to methods of manufacturing such metal strip. More especially, the invention relates to a method of chemically treating metal strip prior to lamination with a thermoplastic material.

Organic-coated metal substrates, for example thermoplastic resin-coated tinplate or blackplate, are used, *inter alia*, in the production of packaging materials, for example, food and beverage cans. As a result, organic coatings so used, are required to conform with strict performance criteria. To maintain the integrity of a can as well as to ensure that its contents are maintained in a suitable condition over a storage period which may span months or even longer, the coating must exhibit good stain resistance, corrosion resistance and resistance to delamination.

Organic coatings have traditionally comprised solvent or water-based lacquers. Recently however, the use of laminated polymer films and coatings, such as thermoplastic resins, has been recognised as a viable alternative.

In practice, organic coatings are not applied directly onto metal strip, such as mild steel or blackplate, because for packaging applications the metal surface is too reactive and underfilm corrosion can spread rapidly. Instead, the can-making industry uses *metallic*-coated mild steels, such as tinplate or electrolytically chromium-coated steel (ECCS) as substrates for

organic coatings.

Currently, a surface-treated mild steel strip may comprise a chrome/CrO_x or tin layer electrochemically deposited so that the final substrate has either a metallic chromium layer of typically from 50 to 150 mg/m² and a chromium oxide/hydroxide layer of typically from 10 to 30 mg/m², or a layer of metallic tin of typically between 5 and 10 g/m². In many applications it is preferred that tinplate is additionally subjected to chromate solution treatment, the amount of oxidisable chromium being between 1 and 10 mg/m².

Unfortunately, electro-plating pre-treatment is a costly and time consuming process. Not only are materials expensive, but the electro-plating process itself consumes large quantities of energy. In addition, this conventional pre-treatment adds an additional production step in the process line, which adds costs in terms of line-time, manpower and through yield.

It has been shown that for some applications, the degree of protection afforded by the ECCS or tin pre-treatment exceeds the performance requirements of the can. For this reason and the disadvantages associated with electroplating discussed above, there is an increasing desire to develop an alternative metal strip pre-treatment which avoids these problems but maintains the performance requirements of certain classes of food, beverage or aerosol cans. Preferably, any such pre-treatment should be capable of application under the present day metal strip coating and lamination line conditions.

In the past, there has been a general understanding in the industry that alternatives to electro-deposited tin and/or chrome would afford significantly less substrate protection. However, if a suitable alternative pre-treatment could be found, an electroplating process step would be unnecessary with consequent increases in yield, savings in energy and

reductions in the overall production costs of laminated metal strip.

It is an object of the present invention to provide a suitable alternative to conventional electroplating of metal strip prior to coating with an organic resin, which provides adequate corrosion protection of the organically coated metal strip and provides and maintains good adhesion to such organic resin coatings.

According to the present invention in one aspect, there is provided a process for producing laminated metal strip which comprises the steps of chemically treating the strip to form on at least one of its surfaces a non-metallic coating, and applying to that coated surface a coating of a thermoplastic resin to form a layer thereon.

The term "non-metallic coatings" as used herein refers to coatings which despite optionally including *metal ions*, differ from what is conventionally described as a metallic layer in that there is no *native* metal. Unlike a metal layer wherein metal atoms, through metallic bonding, *solely* form a crystalline structure, in the non-metallic coatings of the present invention, both metallic and non-metallic ions are distributed within an amorphous network.

In another aspect, the invention provides a process for manufacturing laminated metal strip, the process comprising the steps of:

(a) cleaning metal strip;

(b) chemically pre-treating the cleaned metal strip to form on one or each of its surfaces a non-metallic chemical coating, which resists corrosion of the underlying metal substrate and promotes adhesion to a subsequently applied layer; and,

(c) applying to the chemically-treated metal strip a coating of thermoplastic resin to form a protective layer on at least one surface thereof.

The metal strip may be cold-rolled metal strip.

Typically, the metal strip has a gauge of between 0.08 and 0.50mm. A preferred gauge is 0.18mm.

In particular, it is preferred that the metal strip comprises mild steel (conventionally referred to as blackplate).

Preferably, the metal strip is cleaned to remove all traces of contamination which may be present as a result of previous cold rolling and annealing processes. Typically, the metal strip is cleaned electrolytically using a caustic-based solution, although the nature of the cleaner does not influence the subsequent chemical treatment. After cleaning, the strip may be rinsed with water to remove all traces of the cleaning solution.

The chemical coating may be applied to the metal strip using a conventional application method such as immersion, spraying, roller coating, or a combination thereof.

Typically, the chemical coating is applied by immersing the cleaned metal strip in chemical contained in one or more treatment vessels. In one embodiment, the metal strip is chemically treated for less than 60 seconds; in other embodiments, the chemical treatment times are less than 30 seconds or less than 15 seconds. Preferably, the metal strip is chemically treated for less than 10 seconds; typically, 5 seconds.

Typically, the metal strip is chemically treated at a temperature of less than 100°C, most preferably at less than 30°C.

In one aspect of the invention, the metal strip is chemically treated to form a chemical coating which prevents subsequent underfilm corrosion of the metal strip and promotes adhesion between the metal strip and

thermoplastic resin. The chemical coating may be referred to as a *coupling agent* since it forms a strong and durable *chemical bridge* at the interface between the metal substrate and the final organic resin coating. The chemical bridge has a dual role; it interacts with receptive inorganic surfaces to form tenacious chemical bonds at the interface with the metal substrate *and* at the interface with the organic resin coating.

The chemical coating may comprise an oxyanion such as phosphate, chromate, oxalate or arsenate. Alternatively, or in addition, the coating may comprise yttrium, elements in the lanthanum series of the periodic table, silanes or azoles.

When metal substrates are exposed to the atmosphere, the surface of the metal develops a naturally occurring surface oxide layer. Typically, the oxide layer on blackplate at ambient temperature will have an average thickness of between 2 and 20 mm. Thus, in one embodiment, the chemical coating may be applied to the metal oxide layer on the surface of the metal substrate.

In one embodiment of the invention, the chemical coating comprises silanes. Silanes are a family of organosilicon monomers that are characterised by the formula R-SiX_3, where R is an organofunctional group linked to silicon by a hydrolytically stable bond and X denotes hydrolyzable groups, such as alkoxy groups, which are converted to silanol groups on hydrolysis.

Preferably, the chemical coating comprises $CH_2CH_2CH_2Si(OCH_3)_3$, where R is a reactive functional group and X is the methoxy group.

Without wishing to be bound by any theory, in order to react with the metal strip, the chemical coating may be converted to an active silanol by hydrolysis. In aqueous solution, the hydrolysed silane may react with the

inorganic surface hydroxyl groups on the metal oxide layer.

In order to react with the organic resin layer, organic chemistry predicts the formation of chemical covalent bonds between the organofunctional group of the silane and the reactive species in the organic resin matrix. In addition, the formation of an interpenetrating polymer network of the silane and the organic polymer may involve the formation of a "diffused" polymer at the silane-polymer interface.

Alternatively, the chemical treatment may comprise phosphates, for example zinc orthophosphates, manganese phosphates or iron phosphates, thereby producing crystalline phosphate coatings on the metal substrate.

In a preferred embodiment of the invention the metal strip is chemically coated with a composition comprising less than 5% atomic chromium.

In one embodiment, the chemical coating may comprise a commercially available chemical treatment comprising chromium, silicon and organic active species. Alternatively, the chemical coating may comprise a commercially available chemical treatment comprising a two component organic polymer i.e. an acrylic polymer and $(NH_3)Cr_2O_6$.

After chemical treatment, the metal strip may be rinsed and/or dried, for example with hot air, prior to treatment with organic resin.

One or more layers of thermoplastic resin may be applied to one or both sides of the chemically-treated metal strip. The layer or layers of thermoplastic resin may be melted and rapidly quenched to attain the required degree of crystalline structure.

Typically, a film of thermoplastic resin may be co-extruded with the

chemically-treated metal strip to form laminated metal strip. The film of thermoplastic resin may be bonded to chemically-treated metal strip under conditions of elevated temperature and pressure.

The chemically-treated metal strip may be coated with a thermoplastic resin together with a bonding layer. The bonding layer may comprise a polyester, or an acid or acid-anhydride polyolefin resin containing carboxyl or anhydride groups. Typically, the bonding layer is between 1 and 10μm thick.

Alternatively, the chemically-treated metal strip may be extrusion coated with at least one thermoplastic resin.

Preferred thermoplastic resins comprise polypropylene (PP), polyethyleneteraphthalate (PET) or a combination thereof.

Typically, the thickness of the layer, or layers, of thermoplastic resin are between 3 and 50μm.

The chemical treatment has two functions; firstly it provides corrosion protection and inhibits underfilm corrosion, and secondly, it promotes good adhesion between the organic resin coating and the metal strip. These properties combined with the barrier properties of the organic coating provide a laminated metal strip product which can be formed into components for a range of applications whilst maintaining adequate performance criteria with regard to corrosion resistance and inter layer adhesion during the lifetime of the products.

Therefore, in another aspect, the invention provides a laminated metal strip produced by a process which comprises the steps of chemically treating the strip to form on at least one of its surfaces a non-metallic coating, and applying to that coated surface a coating of a thermoplastic resin to form a

layer thereon.

In another aspect, the invention provides a laminated metal strip produced by a process which comprises the steps of:-

(a) chemically pre-treating metal strip to form on one or each of its surfaces a non-metallic chemical coating, which resists corrosion of the underlying metal substrate and promotes adhesion to a subsequently applied layer; and,

(b) applying to the chemically-treated metal strip a coating of thermoplastic resin to form a protective layer on at least one surface thereof.

In yet another aspect, the invention provides a packaging container comprising such laminated metal strip.

Chemical treatment obviates the need for a metallic coating on the metal strip substrate. As the conventional electroplated metal coating is normally applied on a separate process line to the organic coating line, the omission of this step results in considerable cost and energy savings, as well as increasing through yield.

The invention will now be described by way of example only with reference to the accompanying diagrammatic drawings and tables in which:-

Figure 1 is a histogram showing the performance rating of food-filled cans made from PET-laminated and chemically treated blackplate;

Figure 2 is a histogram showing the performance rating of food-filled cans made from PP-laminated and chemically treated blackplate; and,

Table 1 tabulates the conditions, concentrations and dipping times of exemplary chemical treatments.

A process line for producing laminated blackplate comprises a plurality of guide rollers for transporting a strip of blackplate continuously from a coiled roll to an exit coil via a multiplicity of vertical tanks. These tanks include a cleaning tank, rinsing tanks and a chemical treatment tank. The line speed is typically 10 to 100 metres per minute with a treatment dwell time of between 1 to 10 seconds. After hot-air drying, the chemically treated metal strip is laminated with organic polymeric resin e.g. a thermoplastic resin such as PET at elevated temperature and pressure. The laminated metal strip is then rapidly quenched to produce an essentially amorphous organic outer coating.

By way of example, the performances of two commercially available chemical treatments (referred to below as chemicals A and B) were evaluated as potential alternatives to the conventional electroplating step in the production of an organically coated mild steel strip.

Chemical A comprised a commercially available chemical treatment comprising chromium, silicon and organic active species. Chemical B comprised a commercially available chemical treatment comprising a two component organic polymer i.e. an acrylic polymer and $(NH_3)Cr_2O_6$.

In the evaluation, blackplate of 0.08 to 0.50mm thickness was subjected to an electrolytic cleaning process using a commercial cleaning solution at a temperature not exceeding 100°C, by passing a current of 20A for 5 seconds. This treatment is considered to return current densities to approximately 10 Adm^{-2}. The nature of the cleaner employed on the blackplate does not influence any subsequent chemical treatment. It is important that the metal strip is clean and free of contamination from prior processing. Before dipping in the chemical treatment vessels, the samples were washed in two ambient water rinse tanks. The concentrations of the cleaner and chemical treatments were those recommended by the respective suppliers. A batch of samples exposed only to electrolytic cleaning were

also prepared as a control sample group, identified in Figures 1 and 2 as B-plate.

As well as "cleaned only" samples, an ECCS control sample group was also laminated. Samples of both 15 μm PET and/or 40 μm PP were laminated at elevated temperature and pressure. The hot samples were plunged into cold water just as the current was switched off. Instant quenching of this nature has the effect of retaining the amorphous nature of the thermoplastic coating at ambient temperature. Table 1 illustrates the concentrations, dip times and treatment section temperatures for evaluated chemicals A and B.

Samples of each variable were subjected to a wedge bend test. Both treatments A and B performed equally well; no delamination or cracking of the polymer was observed. A standard Erichsen and cross scored Erichsen were also performed. The samples were evaluated for signs of blisters and/or delamination. Again, both A and B performed well with little to distinguish between them.

About 350, 73mm diameter classic can ends were produced on a conventional MB20 can end press. Approximately 20 samples of each treatment with both PET and PP were produced. A standard lining compound was applied to each end. Half the ends were lightly scored prior to filling with foodstuff to create a standard defect and potentially allow a greater degree of differentiation of the chemical treatments on opening.

8oz cans (73 x 63mm) were filled with either rabbit cat food or cut green beans in salt brine under standard filling conditions. The cans were stored on their sides at an elevated temperature (37°C). Cans with scored ends were stored with the score running vertically so that it entered the head space area. Four cans of each variable were opened after 2, 5, and 15 weeks. Opened cans were evaluated for sulphide staining, delamination and

corrosion (on and off the score line).

The can end performance was judged on three main criteria (sulphide staining, delamination and corrosion (on and off the score line)) using a points system. Three points were awarded if the defect was obviously present and two points if the defect was only minor. No points were allocated if the defect was absent. All points were totalled for each category of defect over the three openings, for both polymer film types and for each chemical pre-treatment. The results are illustrated in Figure 1 and Figure 2.

It should be noted that the performance rating system used here gives equal weighting to each of the attributable defects. Arguably, sulphide staining could be regarded as a less serious defect than delamination as it is only aesthetic and does not directly reflect can performance. Nevertheless, the approach highlights the chemical treatments which perform relatively adequately for use in can-making applications.

In summary, the trials show that chemical pre-treatment in accordance with the invention provides an effective alternative to metallic electroplated coatings prior to coating of metal strip with organic resins.

It may be envisaged that in another embodiment of the invention, blackplate can undergo chemical pre-treatment "off-line" with transfer to the lamination line post treatment. However, this is less cost effective due to the necessity for a separate coating facility and any associated transportation or storage costs.

It will be appreciated that the foregoing is merely exemplary of treatments in accordance with the invention and that modifications can readily be made thereto without departing from the true scope of the invention.

TABLE 1

Chemical Treatment	Working concentration	Dip time (seconds)	Temperature of dip °C
A	3%	1	25
B	as supplied	3	<30

CLAIMS

1. A process for producing laminated metal strip which comprises the steps of chemically treating the strip to form on at least one of its surfaces a non-metallic coating, and applying to that coated surface a coating of a thermoplastic resin to form a layer thereon.

2. A process for manufacturing laminated metal strip, the process comprising the steps of,
   (a) cleaning metal strip;
   (b) chemically pre-treating the cleaned metal strip to form on one or each of its surfaces a non-metallic chemical coating, which resists corrosion of the underlying metal substrate and promotes adhesion to a subsequently applied layer; and,
   (c) applying to the chemically-treated metal strip a coating of thermoplastic resin to form a protective layer on at least one surface thereof.

3. A process according to claim 1 or claim 2 wherein the metal strip is cold-rolled metal strip.

4. A process according to any one of the preceding claims wherein the metal strip has a gauge of between 0.08 and 0.50mm.

5. A process according to claim 4 wherein the metal strip has a gauge of 0.18mm.

6. A process according any one of the preceding claims wherein the metal strip comprises blackplate.

7. A process according to any one of the preceding claims wherein the metal strip is cleaned electrolytically.

8. A process according to any one of the preceding claims wherein the chemical coating is applied to the metal strip by a method of immersion, spraying, roller coating, or a combination thereof.

9. A process according to claim 8 wherein the chemical coating is applied by immersing the metal strip into at least one chemical treatment vessel.

10. A process according to claim 9 wherein the residence time of the metal strip in the chemical-treatment vessel is less than 60 seconds.

11. A process according to claim 10 wherein the residence time of the metal strip in the chemical-treatment vessel is less than 30 seconds.

12. A process according to claim 11 wherein the residence time of the metal strip in the chemical-treatment vessel is less than 15 seconds.

13. A process according to claim 12 wherein the residence time of the metal strip in the chemical-treatment vessel is less than 10 seconds, for example, 5 seconds.

14. A process according to any one of the preceding claims wherein the metal strip is chemically treated at a temperature of less than 100°C, for example less than 30°C.

15. A process according to any one of the preceding claims wherein the metal strip is chemically treated to form an anti-corrosive, adhesion promoting chemical coating between the metal strip and thermoplastic resin.

16. A process according to any one of the preceding claims wherein the chemical coating comprises an oxyanion such as phosphate,

chromate, oxalate or arsenate.

17. A process according to claim 16 wherein the chemical coating comprises a two component organic polymer.

18. A process according to claim 16 wherein the chemical coating comprises chromium, silicon and an organic active species.

19. A process according to any one of the preceding claims wherein the chemical coating comprises yttrium, elements in the lanthanum series of the periodic table, silanes or azoles.

20. A process according to claim 19 wherein the chemical coating comprises silanes of the general formula,

$$R\text{-}SiX_3,$$

where R is an organofunctional group linked to silicon by a hydrolytically stable bond and X denotes hydrolyzable groups, e.g. alkoxy groups, which are converted to silanol groups on hydrolysis.

21. A process according to claim 20 wherein the chemical coating comprises a silane of the general formula,

$$RCH_2CH_2CH_2Si(OCH_3)_3,$$

where R is a reactive functional group and X is the methoxy group.

22. A process according to claim 16 wherein the chemical coating comprises a phosphate such as zinc orthophosphates, manganese phosphates or iron phosphates.

23. A process according to any one of the preceding claims wherein the chemical coating comprises less than 5 atomic % chromium.

24. A process according to any one of the preceding claims wherein the

chemically-treated metal strip is rinsed and/or dried prior to organic resin coating.

25. A process according to any one of the preceding claims wherein one or more layers of thermoplastic resin are applied to one or both sides of the chemically-treated metal strip.

26. A process according to any one of the preceding claims wherein the layer or layers of thermoplastic resin is/are melted and rapidly quenched to attain the required degree of crystalline structure.

27. A process according to any one of the preceding claims wherein the chemically-treated metal strip is extrusion coated with at least one thermoplastic resin.

28. A process according to claim 27 wherein the film of thermoplastic resin is bonded to the chemically-treated metal strip under conditions of elevated temperature and pressure.

29. A process according to any one of the preceding claims wherein the chemically-treated metal strip is coated with thermoplastic resin together with a bonding layer.

30. A process according to claim 29 wherein the bonding layer comprises a polyester or an acid or acid-anhydride polyolefin resin containing carboxyl or anhydride groups.

31. A process according to claim 29 or claim 30 wherein the thickness of the bonding layer is between 1 and 10 μm.

32. A process according to any one of the preceding claims wherein the thermoplastic resin comprises polypropylene (PP),

polyethyleneterephthalate (PET) or a combination thereof.

33. A process according to any one of the preceding claims wherein the thickness of the layer, or layers, of thermoplastic resin is/are between 3 and 50 μm.

34. A process as substantially defined herein and with reference to the accompanying Figures and Table.

35. A laminated metal strip as manufactured by the process as defined in claim 34.

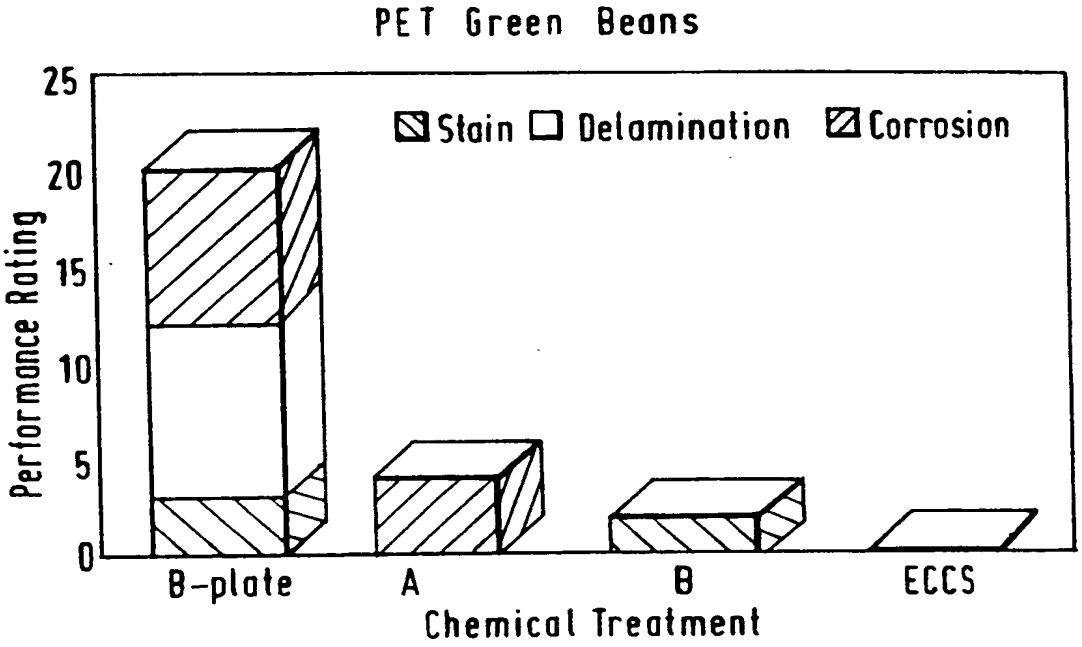
PET Green Beans
Stain
Delamination
Corrosion
Performance Rating
25
20
15
10
5
0
B-plate
A
B
ECCS
Chemical Treatment

Fig.1.

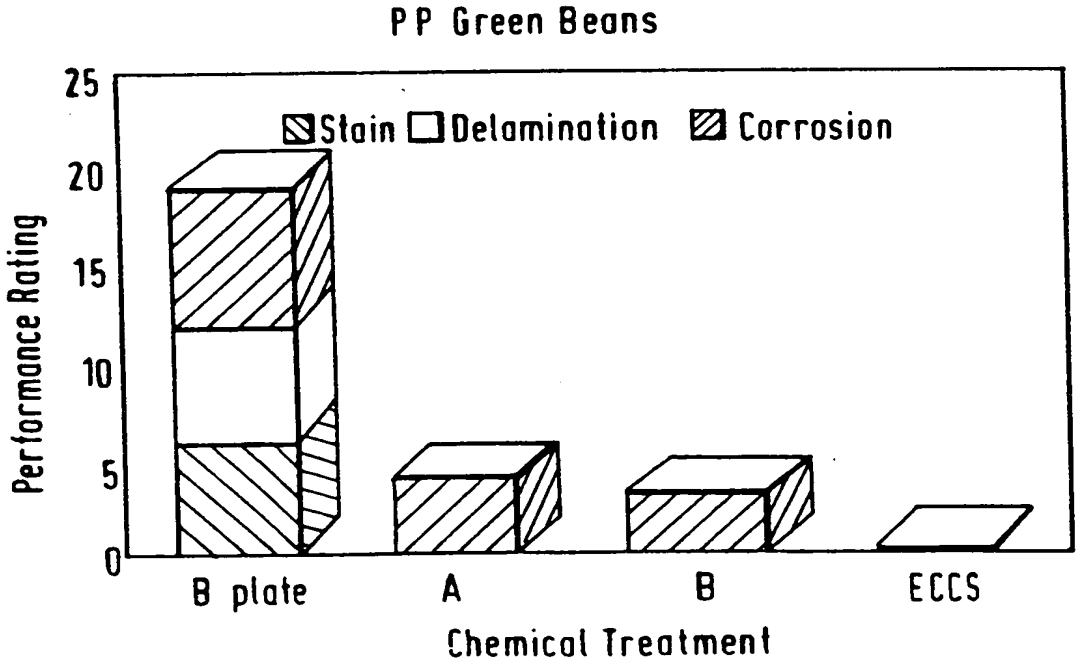
PP Green Beans
Stain
Delamination
Corrosion
Performance Rating
25
20
15
10
5
0
B plate
A
B
ECCS
Chemical Treatment

Fig.2.

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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(74) Agents: FRY, Alan, Valentine et al.; Fry Heath & Spence, The Old College, 53 High Street, Horley, Surrey RH6 7BN (GB).

(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published
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(88) Date of publication of the international search report:
25 November 1999 (25.11.99)

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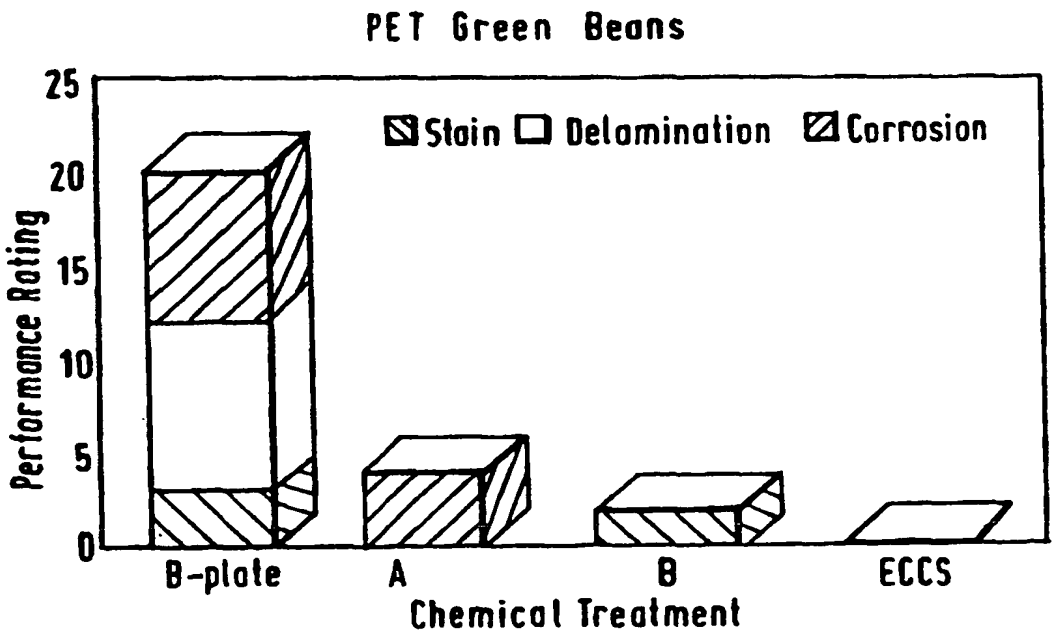

(57) Abstract

A process for producing laminated metal strip which comprises the steps of chemically treating the strip to form on at least one of its surfaces a non–metallic coating, and applying to that coated surface a coating of a thermoplastic resin to form a layer thereon.

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 99/00567

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 B05D7/14 B05D3/10

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 B05D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 97 35716 A (TOYO KOHAN CO LTD ;KOMAI MASAO (JP); SHIRAI SHINJI (JP); SHIMIZU K) 2 October 1997 (1997-10-02) abstract	1,2,4, 7-16, 22-25, 27-35
E	-& GB 2 329 608 A (TOYO KOHAN CO LTD) 31 March 1999 (1999-03-31) the whole document	1,2,4, 7-16, 22-25, 27-35

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
8 July 1999	08.10.99

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	BROTHIER, J

Form PCT/ISA/210 (second sheet) (July 1992)

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 97 35717 A (TOYO KOHAN CO LTD ;KOMAI MASAO (JP); KUNISHIGE FUMIO (JP); SHIMIZU) 2 October 1997 (1997-10-02) abstract	1,2,4, 7-16,22, 24,25, 29-35
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X	PATENT ABSTRACTS OF JAPAN vol. 011, no. 136 (C-419), 30 April 1987 (1987-04-30) & JP 61 274771 A (NIPPON STEEL CORP), 4 December 1986 (1986-12-04) abstract	1,2,15, 16,34,35
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X	-& DATABASE WPI Section Ch, Week 9407, 1994 Derwent Publications Ltd., London, GB; Class A17, AN 94-054184 XP002108642 & JP 06 010152 A (MITSUBISHI HEAVY IND LTD.), 18 January 1994 (1994-01-18) abstract	1,2,8,9, 15,16, 22,23, 25,29, 32,34,35
X	DATABASE WPI Section Ch, Week 8249 Derwent Publications Ltd., London, GB; Class A32, AN 82-05620J XP002108640 & JP 57 176153 A (SHARP KK), 29 October 1982 (1982-10-29) abstract	1-3,15, 16,22, 34,35

-/--

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	PATENT ABSTRACTS OF JAPAN vol. 096, no. 001, 31 January 1996 (1996-01-31) & JP 07 241956 A (TOYO KOHAN CO LTD), 19 September 1995 (1995-09-19) abstract	1,2, 15-18, 22,25, 29,30, 34,35
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/GB 99/00567

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

SEE ANNEX

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-15,22,24-35 and partially 16,17,18

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

1. Claims: 1-15,16(partially),17(partially),18(partially),22, 24-35

Process for making a laminated metal strip comprising the steps of chemically treating the strip to form on at least one of its surface a non-metallic coating, and applying to that coated surface a coating of a thermoplatic resin to form a layer thereon. The chemical coating comprising phosphate oxyanion.

2. Claims: 1-15,16(partially),17(partially),18(partially),22, 24-35

Process for making a laminated metal strip comprising the steps of chemically treating the strip to form on at least one of its surface a non-metallic coating, and applying to that coated surface a coating of a thermoplatic resin to form a layer thereon. The chemical coating comprising chromate oxyanion.

3. Claims: 1-15,16(partially),17(partially),18(partially),22, 24-35

Process for making a laminated metal strip comprising the steps of chemically treating the strip to form on at least one of its surface a non-metallic coating, and applying to that coated surface a coating of a thermoplatic resin to form a layer thereon. The chemical coating comprising oxalate oxyanion.

4. Claims: 1-15,16(partially),17(partially),18(partially),22, 24-35

Process for making a laminated metal strip comprising the steps of chemically treating the strip to form on at least one of its surface a non-metallic coating, and applying to that coated surface a coating of a thermoplatic resin to form a layer thereon. The chemical coating comprising arsenate oxyanion.

5. Claims: 1-15,16(partially),17(partially),18(partially),22, 24-35

Process for making a laminated metal strip comprising the steps of chemically treating the strip to form on at least one of its surface a non-metallic coating, and applying to

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

that coated surface a coating of a thermoplatic resin to form a layer thereon. The chemical coating comprising oxyanions differing from chromates, phosphates, oxalates and arsenates.

6. Claims: 1-15,19(partially),23-35

Process for making a laminated metal strip comprising the steps of chemically treating the strip to form on at least one of its surface a non-metallic coating, and applying to that coated surface a coating of a thermoplatic resin to form a layer thereon. The chemical coating comprising yttrium.

7. Claims: 1-15,19(partially),23-35

Process for making a laminated metal strip comprising the steps of chemically treating the strip to form on at least one of its surface a non-metallic coating, and applying to that coated surface a coating of a thermoplatic resin to form a layer thereon. The chemical coating comprising elements in the lanthanum series of the periodic table.

8. Claims: 1-15,19(partially),20,21,23-35

Process for making a laminated metal strip comprising the steps of chemically treating the strip to form on at least one of its surface a non-metallic coating, and applying to that coated surface a coating of a thermoplatic resin to form a layer thereon. The chemical coating comprising silanes.

9. Claims: 1-15,19(partially),23-35

Process for making a laminated metal strip comprising the steps of chemically treating the strip to form on at least one of its surface a non-metallic coating, and applying to that coated surface a coating of a thermoplatic resin to form a layer thereon. The chemical coating comprising azoles.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/GB 99/00567

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
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			JP	59032546 B	09-08-1984
JP 63072377	A	02-04-1988	NONE		

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

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The Old College
53 High Street
Horley, Surrey RH6 7BN
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NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Rule 71.1)

Date of mailing *(day/month/year)*	13.06.00
Applicant's or agent's file reference P57223F	IMPORTANT NOTIFICATION

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/GB99/00567	02/03/1999	02/03/1998

Applicant
BRITISH STEEL LIMITED et al.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.

2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.

3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. **REMINDER**

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

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European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Langhoff, M Tel.+49 89 2399-8221

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
P57223F		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/GB99/00567	02/03/1999	02/03/1998
International Patent Classification (IPC) or national classification and IPC B05D7/14		
Applicant BRITISH STEEL LIMITED et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 4 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 14 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☒ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
23/07/1999	13.06.00
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer De Waard, W Telephone No. +49 89 2399 2918

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB99/00567

I. Basis of the report

1. This report has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.*):

Description, pages:

1-10	as received on	11/04/2000	with letter of	07/04/2000

Claims, No.:

1-28	as received on	11/04/2000	with letter of	07/04/2000

Drawings, sheets:

1/1	as originally filed

2. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:
- ☐ the drawings, sheets:

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims 1-28
	No:	Claims
Inventive step (IS)	Yes:	Claims 1-28
	No:	Claims
Industrial applicability (IA)	Yes:	Claims 1-28
	No:	Claims

2. Citations and explanations

see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

Re Item V

Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. The nearest prior art document is considered to be WO-A-97 35716, which is published on 02.10.97, i.e. before the priority date of the present application. However, for language reasons, reference will be made to GB-A-2 329 608 (hereinafter referred to as D1), which is the corresponding national application (but published after the prio-date of the present application).

2. D1 discloses a process for producing thermoplastic resin-coated aluminum alloy plate including chemically treating the plate to put the plate surface in such a condition that the increase rate of the specific area is 3-30%. The treated plate is then subjected to anodic oxidation treatment prior to lamination with thermoplastic resin.

3. The subject matter of claim 1 differs from the known process, in that a mild steel strip is coated and in that a non-metallic chemical coating of an oxyanion is applied to the strip.

   These particular features are neither known from the other cited prior documents, nor is therein hinted at.

   As a consequence, the claimed invention must be considered to involve an inventive step.

4. Dependent claims 2-28 define further embodiments of the invention and involve, therefore, an inventive step too.

Re Item VIII

Certain observations on the international application

It is suggested to also specify WO-A-97 35716, to make clear that the prior art discussed above was available before the prio-date of the present application.

PCT

REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

For receiving Office use only

International Application No.

International Filing Date

Name of receiving Office and "PCT International Application"

Applicant's or agent's file reference *(if desired) (12 characters maximum)* P57223F

Box No. I TITLE OF INVENTION

LAMINATED METAL STRIP

Box No. II APPLICANT

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

BRITISH STEEL PLC

15 Marylebone Road
London
NW1 5JD
Great Britain

☐ This person is also inventor.

Telephone No.

Facsimile No.

Teleprinter No.

State *(that is, country)* of nationality: GB

State *(that is, country)* of residence: GB

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

BASTABLE, Brian John

7 Porthway
Bishopston
Swansea SA3 3JF
Great Britain

This person is:

☐ applicant only

☒ applicant and inventor

☐ inventor only *(If this check-box is marked, do not fill in below.)*

State *(that is, country)* of nationality: GB

State *(that is, country)* of residence: GB

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

☐ Further applicants and/or (further) inventors are indicated on a continuation sheet.

Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE

The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as: ☒ agent ☐ common representative

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

FRY, Alan Valentine

Fry Heath & Spence
The Old College
53 High Street
Horley
Surrey RH6 7BN, Great Britain

Telephone No. +44 1293 776880

Facsimile No. +44 1293 776837

Teleprinter No.

☐ **Address for correspondence:** Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

Continuation of Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

If none of the following sub-boxes is used, this sheet should not be included in the request.

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

MALLACE, Malcolm Robert

48 Beechwood Road
Uplands
Swansea SA2 0JD
Great Britain

This person is:
- [ ] applicant only
- [X] applicant and inventor
- [ ] inventor only *(If this check-box is marked, do not fill in below.)*

State *(that is, country)* of nationality: GB

State *(that is, country)* of residence: GB

This person is applicant for the purposes of:
- [ ] all designated States
- [ ] all designated States except the United States of America
- [X] the United States of America only
- [ ] the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

REES, Ieuan Stephen

Tynywern
Upper Mill Road
Pontardulais
Swansea SA4 1NF
Great Britain

This person is:
- [ ] applicant only
- [X] applicant and inventor
- [ ] inventor only *(If this check-box is marked, do not fill in below.)*

State *(that is, country)* of nationality: GB

State *(that is, country)* of residence: GB

This person is applicant for the purposes of:
- [ ] all designated States
- [ ] all designated States except the United States of America
- [X] the United States of America only
- [ ] the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

This person is:
- [ ] applicant only
- [ ] applicant and inventor
- [ ] inventor only *(If this check-box is marked, do not fill in below.)*

State *(that is, country)* of nationality:

State *(that is, country)* of residence:

This person is applicant for the purposes of:
- [ ] all designated States
- [ ] all designated States except the United States of America
- [ ] the United States of America only
- [ ] the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

This person is:
- [ ] applicant only
- [ ] applicant and inventor
- [ ] inventor only *(If this check-box is marked, do not fill in below.)*

State *(that is, country)* of nationality:

State *(that is, country)* of residence:

This person is applicant for the purposes of:
- [ ] all designated States
- [ ] all designated States except the United States of America
- [ ] the United States of America only
- [ ] the States indicated in the Supplemental Box

- [ ] Further applicants and/or (further) inventors are indicated on another continuation sheet.

Box No.V DESIGNATION OF STATES

The following designations are hereby made under Rule 4.9(a) *(mark the applicable check-boxes; at least one must be marked)*:

Regional Patent

- ☒ AP **ARIPO Patent:** GH Ghana, GM Gambia, KE Kenya, LS Lesotho, MW Malawi, SD Sudan, SZ Swaziland, UG Uganda, ZW Zimbabwe, and any other State which is a Contracting State of the Harare Protocol and of the PCT
- ☒ EA **Eurasian Patent:** AM Armenia, AZ Azerbaijan, BY Belarus, KG Kyrgyzstan, KZ Kazakhstan, MD Republic of Moldova, RU Russian Federation, TJ Tajikistan, TM Turkmenistan, and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT
- ☒ EP **European Patent:** AT Austria, BE Belgium, CH and LI Switzerland and Liechtenstein, CY Cyprus, DE Germany, DK Denmark, ES Spain, FI Finland, FR France, GB United Kingdom, GR Greece, IE Ireland, IT Italy, LU Luxembourg, MC Monaco, NL Netherlands, PT Portugal, SE Sweden, and any other State which is a Contracting State of the European Patent Convention and of the PCT
- ☒ OA **OAPI Patent:** BF Burkina Faso, BJ Benin, CF Central African Republic, CG Congo, CI Côte d'Ivoire, CM Cameroon, GA Gabon, GN Guinea, GW Guinea-Bissau, ML Mali, MR Mauritania, NE Niger, SN Senegal, TD Chad, TG Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT *(if other kind of protection or treatment desired, specify on dotted line)* .....

National Patent *(if other kind of protection or treatment desired, specify on dotted line)*:

- ☒ AL Albania .....
- ☒ AM Armenia .....
- ☒ AT Austria .....
- ☒ AU Australia .....
- ☒ AZ Azerbaijan
- ☒ BA Bosnia and Herzegovina .....
- ☒ BB Barbados
- ☒ BG Bulgaria .....
- ☒ BR Brazil .....
- ☒ BY Belarus .....
- ☒ CA Canada
- ☒ CH and LI Switzerland and Liechtenstein
- ☒ CN China .....
- ☒ CU Cuba .....
- ☒ CZ Czech Republic .....
- ☒ DE Germany .....
- ☒ DK Denmark .....
- ☒ EE Estonia .....
- ☒ ES Spain .....
- ☒ FI Finland .....
- ☒ GB United Kingdom
- ☒ GD Grenada
- ☒ GE Georgia .....
- ☒ GH Ghana .....
- ☒ GM Gambia
- ☒ HR Croatia .....
- ☒ HU Hungary .....
- ☒ ID Indonesia
- ☒ IL Israel .....
- ☒ IN India .....
- ☒ IS Iceland
- ☒ JP Japan .....
- ☒ KE Kenya .....
- ☒ KG Kyrgyzstan .....
- ☒ KP Democratic People's Republic of Korea .....
- ☒ KR Republic of Korea .....
- ☒ KZ Kazakhstan .....
- ☒ LC Saint Lucia
- ☒ LK Sri Lanka
- ☒ LR Liberia
- ☒ LS Lesotho .....
- ☒ LT Lithuania
- ☒ LU Luxembourg
- ☒ LV Latvia
- ☒ MD Republic of Moldova .....
- ☒ MG Madagascar .....
- ☒ MK The former Yugoslav Republic of Macedonia .....
- ☒ MN Mongolia
- ☒ MW Malawi .....
- ☒ MX Mexico .....
- ☒ NO Norway
- ☒ NZ New Zealand .....
- ☒ PL Poland .....
- ☒ PT Portugal .....
- ☒ RO Romania
- ☒ RU Russian Federation .....
- ☒ SD Sudan
- ☒ SE Sweden
- ☒ SG Singapore
- ☒ SI Slovenia .....
- ☒ SK Slovakia .....
- ☒ SL Sierra Leone
- ☒ TJ Tajikistan .....
- ☒ TM Turkmenistan .....
- ☒ TR Turkey .....
- ☒ TT Trinidad and Tobago .....
- ☒ UA Ukraine .....
- ☒ UG Uganda .....
- ☒ US United States of America .....
- ☒ UZ Uzbekistan .....
- ☒ VN Viet Nam .....
- ☒ YU Yugoslavia .....
- ☒ ZW Zimbabwe .....

Check-boxes reserved for designating States (for the purposes of a national patent) which have become party to the PCT after issuance of this sheet:

- ☐ .....
- ☐ .....
- ☐ .....

Precautionary Designation Statement: In addition to the designations made above, the applicant also makes under Rule 4.9(b) all other designations which would be permitted under the PCT except any designation(s) indicated in the Supplemental Box as being excluded from the scope of this statement. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. *(Confirmation of a designation consists of the filing of a notice specifying that designation and the payment of the designation and confirmation fees. Confirmation must reach the receiving Office within the 15-month time limit.)*

Supplemental Box *If the Supplemental Box is not used, this sheet should not be included in the request.*

1. If, in any of the Boxes, the space is insufficient to furnish all the information: in such case, write "Continuation of Box No. ..." [indicate the number of the Box] and furnish the information in the same manner as required according to the captions of the Box in which the space was insufficient, in particular:

(i) if more than two persons are involved as applicants and/or inventors and no "continuation sheet" is available: in such case, write "Continuation of Box No. III" and indicate for each additional person the same type of information as required in Box No. III. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below;

(ii) if, in Box No. II or in any of the sub-boxes of Box No. III, the indication "the States indicated in the Supplemental Box" is checked: in such case, write "Continuation of Box No. II" or "Continuation of Box No. III" or "Continuation of Boxes No. II and No. III" (as the case may be), indicate the name of the applicant(s) involved and, next to (each) such name, the State(s) (and/or, where applicable, ARIPO, Eurasian, European or OAPI patent) for the purposes of which the named person is applicant;

(iii) if, in Box No. II or in any of the sub-boxes of Box No. III, the inventor or the inventor/applicant is not inventor for the purposes of all designated States or for the purposes of the United States of America: in such case, write "Continuation of Box No. II" or "Continuation of Box No. III" or "Continuation of Boxes No. II and No. III" (as the case may be), indicate the name of the inventor(s) and, next to (each) such name, the State(s) (and/or, where applicable, ARIPO, Eurasian, European or OAPI patent) for the purposes of which the named person is inventor;

(iv) if, in addition to the agent(s) indicated in Box No. IV, there are further agents: in such case, write "Continuation of Box No. IV" and indicate for each further agent the same type of information as required in Box No. IV;

(v) if, in Box No. V, the name of any State (or OAPI) is accompanied by the indication "patent of addition," or "certificate of addition," or if, in Box No. V, the name of the United States of America is accompanied by an indication "continuation" or "continuation-in-part": in such case, write "Continuation of Box No. V" and the name of each State involved (or OAPI), and after the name of each such State (or OAPI), the number of the parent title or parent application and the date of grant of the parent title or filing of the parent application;

(vi) if, in Box No. VI, there are more than three earlier applications whose priority is claimed: in such case, write "Continuation of Box No. VI" and indicate for each additional earlier application the same type of information as required in Box No. VI;

(vii) if, in Box No. VI, the earlier application is an ARIPO application: in such case, write "Continuation of Box No. VI", specify the number of the item corresponding to that earlier application and indicate at least one country party to the Paris Convention for the Protection of Industrial Property for which that earlier application was filed.

2. If, with regard to the precautionary designation statement contained in Box No. V, the applicant wishes to exclude any State(s) from the scope of that statement: in such case, write "Designation(s) excluded from precautionary designation statement" and indicate the name or two-letter code of each State so excluded.

3. If the applicant claims, in respect of any designated Office, the benefits of provisions of the national law concerning non-prejudicial disclosures or exceptions to lack of novelty: in such case, write "Statement concerning non-prejudicial disclosures or exceptions to lack of novelty" and furnish that statement below.

Continuation of Box No. IV

HUTCHINS, Michael Richard; DOWNING, Michael Philip; PRICE, Vincent Andrew; UNWIN, Stephen Geoffrey; SPENCE, Anne; all of Fry Heath & Spence, The Old College, 53 High Street, Horley, Surrey RH6 7BN, Great Britain

Box No. VI PRIORITY CLAIM ☐ Further priority claims are indicated in the Supplemental Box.

Filing date of earlier application (day/month/year)	Number of earlier application	Where earlier application is: national application: country	regional application:* regional Office	international application: receiving Office
item (1) 02.03.1998	9804297.1	GB		
item (2)				
item (3)				

☒ The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) *(only if the earlier application was filed with the Office which for the purposes of the present international application is the receiving Office)* identified above as item(s): (1)

* *Where the earlier application is an ARIPO application, it is mandatory to indicate in the Supplemental Box at least one country party to the Paris Convention for the Protection of Industrial Property for which that earlier application was filed (Rule 4.10(b)(ii)). See Supplemental Box.*

Box No. VII INTERNATIONAL SEARCHING AUTHORITY

Choice of International Searching Authority (ISA) *(if two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used):* ISA /

Request to use results of earlier search; reference to that search *(if an earlier search has been carried out by or requested from the International Searching Authority):*

Date *(day/month/year)* Number Country *(or regional Office)*

Box No. VIII CHECK LIST; LANGUAGE OF FILING

This international application contains the following **number of sheets**:

request	:	5
description (excluding sequence listing part)	:	12
claims	:	5
abstract	:	1
drawings	:	1
sequence listing part of description	:	
Total number of sheets	:	24

This international application is **accompanied by** the item(s) marked below:

1. ☐ fee calculation sheet
2. ☐ separate signed power of attorney
3. ☐ copy of general power of attorney; reference number, if any:
4. ☐ statement explaining lack of signature
5. ☐ priority document(s) identified in Box No. VI as item(s):
6. ☐ translation of international application into (language):
7. ☐ separate indications concerning deposited microorganism or other biological material
8. ☐ nucleotide and/or amino acid sequence listing in computer readable form
9. ☐ other *(specify)*:

Figure of the drawings which should accompany the abstract: 1

Language of filing of the international application: English

Box No. IX SIGNATURE OF APPLICANT OR AGENT

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).

A.V. Fry

For receiving Office use only

1. Date of actual receipt of the purported international application:
2. Drawings: ☐ received: ☐ not received:
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:
4. Date of timely receipt of the required corrections under PCT Article 11(2):
5. International Searching Authority (if two or more are competent): ISA /
6. ☐ Transmittal of search copy delayed until search fee is paid.

For International Bureau use only

Date of receipt of the record copy by the International Bureau:

16

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
P57223F		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/GB99/00567	02/03/1999	02/03/1998
International Patent Classification (IPC) or national classification and IPC B05D7/14		
Applicant [BRITISH STEEL LIMITED et al.] CORUS UK LIMITED		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 4 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 14 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☒ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
23/07/1999	13.06.00
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer De Waard, W Telephone No. +49 89 2399 2918

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB99/00567

I. Basis of the report

1. This report has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.*):

Description, pages:

1-10	as received on	11/04/2000	with letter of	07/04/2000

Claims, No.:

1-28	as received on	11/04/2000	with letter of	07/04/2000

Drawings, sheets:

1/1	as originally filed

2. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:
- ☐ the drawings, sheets:

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims 1-28
	No:	Claims
Inventive step (IS)	Yes:	Claims 1-28
	No:	Claims
Industrial applicability (IA)	Yes:	Claims 1-28
	No:	Claims

2. Citations and explanations

see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

Re Item V

Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. The nearest prior art document is considered to be WO-A-97 35716, which is published on 02.10.97, i.e. before the priority date of the present application. However, for language reasons, reference will be made to GB-A-2 329 608 (hereinafter referred to as D1), which is the corresponding national application (but published after the prio-date of the present application).

2. D1 discloses a process for producing thermoplastic resin-coated aluminum alloy plate including chemically treating the plate to put the plate surface in such a condition that the increase rate of the specific area is 3-30%. The treated plate is then subjected to anodic oxidation treatment prior to lamination with thermoplastic resin.

3. The subject matter of claim 1 differs from the known process, in that a mild steel strip is coated and in that a non-metallic chemical coating of an oxyanion is applied to the strip.

   These particular features are neither known from the other cited prior documents, nor is therein hinted at.

   As a consequence, the claimed invention must be considered to involve an inventive step.

4. Dependent claims 2-28 define further embodiments of the invention and involve, therefore, an inventive step too.

Re Item VIII

Certain observations on the international application

It is suggested to also specify WO-A-97 35716, to make clear that the prior art discussed above was available before the prio-date of the present application.

LAMINATED MILD STEEL STRIP

This invention relates to laminated mild steel strip for use especially, but not exclusively, in the packaging industry and to methods of manufacturing such strip. More especially, the invention relates to a method of chemically treating mild steel strip prior to lamination with a thermoplastic material.

Organic-coated metal substrates, for example thermoplastic resin-coated tinplate or blackplate, are used, *inter alia*, in the production of packaging materials, for example, food and beverage cans. As a result, organic coatings so used, are required to conform with strict performance criteria. To maintain the integrity of a can as well as to ensure that its contents are maintained in a suitable condition over a storage period which may span months or even longer, the coating must exhibit good stain resistance, corrosion resistance and resistance to delamination.

GB-A-2329608A discloses a process for producing thermoplastic resin-coated aluminium alloy plate in which the plate is treated sequentially with alkali and acid solutions to put the plate surfaces in such a condition that the increase rate of the specific surface area is 3 to 30%. The treated plate is then subjected to an anodic oxidation treatment prior to lamination with thermoplastic resin.

Organic coatings have traditionally comprised solvent or water-based

lacquers. Recently however, the use of laminated polymer films and coatings, such as thermoplastic resins, has been recognised as a viable alternative.

In practice, organic coatings are not applied directly onto mild steel (otherwise known as blackplate), because for packaging applications the metal surface is too reactive and underfilm corrosion can spread rapidly. Instead, the can-making industry uses *metallic*-coated mild steels, such as tinplate or electrolytically chromium-coated steel (ECCS) as substrates for organic coatings.

Currently, a surface-treated mild steel strip may comprise a chrome/CrO_x or tin layer electrochemically deposited so that the final substrate has either a metallic chromium layer of typically from 50 to 150 mg/m² and a chromium oxide/hydroxide layer of typically from 10 to 30 mg/m², or a layer of metallic tin of typically between 5 and 10 g/m². In many applications it is preferred that tinplate is additionally subjected to chromate solution treatment, the amount of oxidisable chromium being between 1 and 10 mg/m².

Unfortunately, electro-plating pre-treatment is a costly and time consuming process. Not only are materials expensive, but the electro-plating process itself consumes large quantities of energy. In addition, this conventional pre-treatment adds an additional production step in the process line, which adds costs in terms of line-time, manpower and through yield.

It has been shown that for some applications, the degree of protection afforded by the ECCS or tin pre-treatment exceeds the performance requirements of the can. For this reason and the disadvantages associated with electroplating discussed above, there is an increasing desire to develop an alternative metal strip pre-treatment which avoids these problems but maintains the performance requirements of certain classes of food, beverage or aerosol cans. Preferably, any such pre-treatment should be capable of application under

the present day metal strip coating and lamination line conditions.

In the past, there has been a general understanding in the industry that alternatives to electro-deposited tin and/or chrome would afford significantly less substrate protection. However, if a suitable alternative pre-treatment could be found, an electroplating process step would be unnecessary with consequent increases in yield, savings in energy and reductions in the overall production costs of laminated metal strip.

It is an object of the present invention to provide a suitable alternative to conventional electroplating of metal strip prior to coating with an organic resin, which provides adequate corrosion protection of the organically coated metal strip and provides and maintains good adhesion to such organic resin coatings.

According to the present invention in one aspect, there is provided a process for manufacturing laminated mild steel strip, the process comprising the steps of,

(a) cleaning the strip;

(b) chemically pre-treating the cleaned strip to form on one or each of its surfaces a non-metallic chemical coating of an oxyanion to resist corrosion of the underlying mild steel substrate and to promote adhesion to a subsequently applied layer; and,

(c) applying to the chemically-treated strip a coating of thermoplastic resin to form a protective layer on at least one surface thereof.

The term "non-metallic coatings" as used herein refers to coatings which despite optionally including *metal ions*, differ from what is conventionally described as a metallic layer in that there is no *native* metal. Unlike a metal layer wherein metal atoms, through metallic bonding, *solely* form a crystalline structure, in the non-metallic coatings of the present invention, both metallic and non-metallic ions are distributed within an amorphous network.

The strip may be cold-rolled mild steel strip. Mild steel strip is conventionally referred to as blackplate.

Typically, the strip has a gauge of between 0.08 and 0.50mm. A preferred gauge is 0.18mm.

Preferably, the strip is cleaned to remove all traces of contamination which may be present as a result of previous cold rolling and annealing processes. Typically, the strip is cleaned electrolytically using a caustic-based solution, although the nature of the cleaner does not influence the subsequent chemical treatment. After cleaning, the strip may be rinsed with water to remove all traces of the cleaning solution.

The chemical coating may be applied to the strip using a conventional application method such as immersion, spraying, roller coating, or a combination thereof.

Typically, the chemical coating is applied by immersing the cleaned strip in chemical contained in one or more treatment vessels. In one embodiment, the strip is chemically treated for less than 60 seconds; in other embodiments, the chemical treatment times are less than 30 seconds or less than 15 seconds. Preferably, the strip is chemically treated for less than 10 seconds; typically, 5 seconds.

Typically, the strip is chemically treated at a temperature of less than 100°C, most preferably at less than 30°C.

In one aspect of the invention, the strip is chemically treated to form a chemical coating which prevents subsequent underfilm corrosion of the strip and promotes adhesion between the strip and thermoplastic resin. The chemical coating may be referred to as a *coupling agent* since it forms a strong

and durable *chemical bridge* at the interface between the metal substrate and the final organic resin coating. The chemical bridge has a dual role; it interacts with receptive inorganic surfaces to form tenacious chemical bonds at the interface with the metal substrate *and* at the interface with the organic resin coating.

The oxyanion coating may comprise a phosphate, a chromate, an oxalate or an arsenate. Additionally, the coating may comprise yttrium, elements in the lanthanum series of the periodic table, silanes or azoles.

When metal substrates are exposed to the atmosphere, the surface of the metal develops a naturally occurring surface oxide layer. Typically, the oxide layer on blackplate at ambient temperature will have an average thickness of between 2 and 20 mm. Thus, in one embodiment, the chemical coating may be applied to the metal oxide layer on the surface of the metal substrate.

The chemical treatment may comprise, for example zinc orthophosphates, manganese phosphates or iron phosphates, thereby producing crystalline phosphate coatings on the strip.

In a preferred embodiment of the invention the strip is chemically coated with a composition comprising less than 5% atomic chromium.

After chemical treatment, the strip may be rinsed and/or dried, for example with hot air, prior to treatment with organic resin.

One or more layers of thermoplastic resin may be applied to one or both sides of the chemically-treated strip. The layer or layers of thermoplastic resin may be melted and rapidly quenched to attain the required degree of crystalline structure.

Typically, a film of thermoplastic resin may be co-extruded with the chemically-treated strip to form laminated strip. The film of thermoplastic resin may be bonded to chemically-treated strip under conditions of elevated temperature and pressure.

The chemically-treated strip may be coated with a thermoplastic resin together with a bonding layer. The bonding layer may comprise a polyester, or an acid or acid-anhydride polyolefin resin containing carboxyl or anhydride groups. Typically, the bonding layer is between 1 and 10μm thick.

Alternatively, the chemically-treated strip may be extrusion coated with at least one thermoplastic resin.

Preferred thermoplastic resins comprise polypropylene (PP), polyethyleneteraphthalate (PET) or a combination thereof.

Typically, the thickness of the layer, or layers, of thermoplastic resin are between 3 and 50μm.

The chemical treatment has two functions; firstly it provides corrosion protection and inhibits underfilm corrosion, and secondly, it promotes good adhesion between the organic resin coating and the strip. These properties combined with the barrier properties of the organic coating provide a laminated metal strip product which can be formed into components for a range of applications whilst maintaining adequate performance criteria with regard to eorrosion resistance and inter layer adhesion during the lifetime of the products.

Therefore, in another aspect, the invention provides a laminated strip produced by a process which comprises the steps of chemically treating the strip to form on at least one of its surfaces a non-metallic coating, and applying to that coated surface a coating of a thermoplastic resin to form a layer thereon.

The invention will now be described by way of example only with reference to the accompanying diagrammatic drawings and tables in which:-

Figure 1 is a histogram showing the performance rating of food-filled cans made from PET-laminated and chemically treated blackplate;

Figure 2 is a histogram showing the performance rating of food-filled cans made from PP-laminated and chemically treated blackplate; and,

Table 1 tabulates the conditions, concentrations and dipping times of exemplary chemical treatments.

A process line for producing laminated blackplate comprises a plurality of guide rollers for transporting a strip of blackplate continuously from a coiled roll to an exit coil via a multiplicity of vertical tanks. These tanks include a cleaning tank, rinsing tanks and a chemical treatment tank. The line speed is typically 10 to 100 metres per minute with a treatment dwell time of between 1 to 10 seconds. After hot-air drying, the chemically treated strip is laminated with organic polymeric resin e.g. a thermoplastic resin such as PET at elevated temperature and pressure. The laminated strip is then rapidly quenched to produce an essentially amorphous organic outer coating.

By way of example, the performances of two commercially available chemical treatments (referred to below as chemicals A and B) were evaluated as potential alternatives to the conventional electroplating step in the production of an organically coated mild steel strip.

Chemical A comprised a commercially available chemical treatment comprising chromium, silicon and organic active species. Chemical B comprised a commercially available chemical treatment comprising a two component

organic polymer i.e. an acrylic polymer and $(NH_3)Cr_2O_6$.

In the evaluation, blackplate of 0.08 to 0.50mm thickness was subjected to an electrolytic cleaning process using a commercial cleaning solution at a temperature not exceeding 100°C, by passing a current of 20A for 5 seconds. This treatment is considered to return current densities to approximately 10 Adm^{-2}. The nature of the cleaner employed on the blackplate does not influence any subsequent chemical treatment. It is important that the strip is clean and free of contamination from prior processing. Before dipping in the chemical treatment vessels, the samples were washed in two ambient water rinse tanks. The concentrations of the cleaner and chemical treatments were those recommended by the respective suppliers. A batch of samples exposed only to electrolytic cleaning were also prepared as a control sample group, identified in Figures 1 and 2 as B-plate.

As well as "cleaned only" samples, an ECCS control sample group was also laminated. Samples of both 15 μm PET and/or 40 μm PP were laminated at elevated temperature and pressure. The hot samples were plunged into cold water just as the current was switched off. Instant quenching of this nature has the effect of retaining the amorphous nature of the thermoplastic coating at ambient temperature. Table 1 illustrates the concentrations, dip times and treatment section temperatures for evaluated chemicals A and B.

Samples of each variable were subjected to a wedge bend test. Both treatments A and B performed equally well; no delamination or cracking of the polymer was observed. A standard Erichsen and cross scored Erichsen were also performed. The samples were evaluated for signs of blisters and/or delamination. Again, both A and B performed well with little to distinguish between them.

About 350, 73mm diameter classic can ends were produced on a

conventional MB20 can end press. Approximately 20 samples of each treatment with both PET and PP were produced. A standard lining compound was applied to each end. Half the ends were lightly scored prior to filling with foodstuff to create a standard defect and potentially allow a greater degree of differentiation of the chemical treatments on opening.

8oz cans (73 x 63mm) were filled with either rabbit cat food or cut green beans in salt brine under standard filling conditions. The cans were stored on their sides at an elevated temperature (37°C). Cans with scored ends were stored with the score running vertically so that it entered the head space area. Four cans of each variable were opened after 2, 5, and 15 weeks. Opened cans were evaluated for sulphide staining, delamination and corrosion (on and off the score line).

The can end performance was judged on three main criteria (sulphide staining, delamination and corrosion (on and off the score line)) using a points system. Three points were awarded if the defect was obviously present and two points if the defect was only minor. No points were allocated if the defect was absent. All points were totalled for each category of defect over the three openings, for both polymer film types and for each chemical pre-treatment. The results are illustrated in Figure 1 and Figure 2.

It should be noted that the performance rating system used here gives equal weighting to each of the attributable defects. Arguably, sulphide staining could be regarded as a less serious defect than delamination as it is only aesthetic and does not directly reflect can performance. Nevertheless, the approach highlights the chemical treatments which perform relatively adequately for use in can-making applications.

In summary, the trials show that chemical pre-treatment in accordance with the invention provides an effective alternative to metallic electroplated

coatings prior to coating of strip with organic resins.

It may be envisaged that in another embodiment of the invention, blackplate can undergo chemical pre-treatment "off-line" with transfer to the lamination line post treatment. However, this is less cost effective due to the necessity for a separate coating facility and any associated transportation or storage costs.

It will be appreciated that the foregoing is merely exemplary of treatments in accordance with the invention and that modifications can readily be made thereto without departing from the true scope of the invention.

TABLE 1

Chemical Treatment	Working concentration	Dip time (seconds)	Temperature of dip °C
A	3%	1	25
B	as supplied	3	<30

CLAIMS

1. A process for manufacturing laminated mild steel strip, the process comprising the steps of,
   (a) cleaning the strip;
   (b) chemically pre-treating the cleaned strip to form on one or each of its surfaces a non-metallic chemical coating of an oxyanion to resist corrosion of the underlying mild steel substrate and to promote adhesion to a subsequently applied layer; and,
   (c) applying to the chemically-treated strip a coating of thermoplastic resin to form a protective layer on at least one surface thereof.

2. A process according to claim 1 wherein the mild steel strip is cold-rolled.

3. A process according to any one of the preceding claims wherein the strip has a gauge of between 0.08 and 0.50mm.

4. A process according to claim 3 wherein the strip has a gauge of 0.18mm.

5. A process according to any one of the preceding claims wherein the strip is cleaned electrolytically.

6. A process according to any one of the preceding claims wherein the chemical coating is applied to the strip by a method of immersion, spraying, roller coating, or a combination thereof.

7. A process according to claim 6 wherein the chemical coating is applied by immersing the strip into at least one chemical treatment vessel.

8. A process according to claim 7 wherein the residence time of the strip

in the chemical-treatment vessel is less than 60 seconds.

9. A process according to claim 8 wherein the residence time of the strip in the chemical-treatment vessel is less than 30 seconds.

10. A process according to claim 9 wherein the residence time of the strip in the chemical-treatment vessel is less than 15 seconds.

11. A process according to claim 10 wherein the residence time of the strip in the chemical-treatment vessel is less than 10 seconds.

12. A process according to any one of the preceding claims wherein the strip is chemically treated at a temperature of less than 100°C.

13. A process according to any one of the preceding claims wherein the strip is chemically treated to form an anti-corrosive, adhesion promoting chemical coating between the strip and thermoplastic resin.

14. A process according to any one of the preceding claims wherein the oxyanion coating comprises a phosphate, a chromate, an oxalate or an arsenate.

15. A process according to claim 14 wherein the chemical coating includes a two component organic polymer.

16. A process according to claim 14 wherein the chemical coating includes chromium, silicon and an organic active species.

17. A process according to claim 14 wherein the chemical coating comprises a phosphate such as zinc orthophosphates, manganese phosphates or

iron phosphates.

18. A process according to any one of the preceding claims wherein the chemical coating comprises less than 5 atomic % chromium.

19. A process according to any one of the preceding claims wherein the chemically-treated strip is rinsed and/or dried prior to organic resin coating.

20. A process according to any one of the preceding claims wherein one or more layers of thermoplastic resin are applied to one or both sides of the chemically-treated strip.

21. A process according to any one of the preceding claims wherein the layer or layers of thermoplastic resin is/are melted and rapidly quenched to attain the required degree of crystalline structure.

22. A process according to any one of the preceding claims wherein the chemically-treated strip is extrusion coated with at least one thermoplastic resin.

23. A process according to claim 22 wherein the film of thermoplastic resin is bonded to the chemically-treated strip under conditions of elevated temperature and pressure.

24. A process according to any one of the preceding claims wherein the chemically-treated strip is coated with thermoplastic resin together with a bonding layer.

25. A process according to claim 24 wherein the bonding layer comprises a polyester or an acid or acid-anhydride polyolefin resin containing carboxyl

or anhydride groups.

26. A process according to claim 24 or claim 25 wherein the thickness of the bonding layer is between 1 and 10 μm.

27. A process according to any one of the preceding claims wherein the thermoplastic resin comprises polypropylene (PP), polyethyleneterephthalate (PET) or a combination thereof.

28. A process according to any one of the preceding claims wherein the thickness of the layer, or layers, of thermoplastic resin is/are between 3 and 50 μm.

INTERNATIONAL SEARCH REPORT

Information on patent family members

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